GRAVITY VEHICLE

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Teams design, build, and test one vehicle and ramp that uses gravitational potential energy as the vehicle's sole means of propulsion to reach a Target Point as quickly, as accurately, and as close to their predicted time as possible.

   A TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** No **APPROXIMATE TIME: 8** minutes

2. **EVENT PARAMETERS:**
   a. Teams must bring one vehicle and one ramp. Teams may bring any tools **or calculation devices.**
   b. The Event Supervisor will provide all measurement tools, starting pencil and timers.
3. **CONSTRUCTION PARAMETERS:**
   a. Vehicles must be designed to travel between 5.000 and 10.000 meters, come to a complete stop, and be as close as possible to their predicted time. The exact **target** distance (in 50.0 cm intervals for regional, 10.0 cm intervals for state and 1.0 cm intervals for national tournaments) must be chosen by the Event Supervisor after all vehicles and ramps have been impounded. **The same target distance will be used for all competitors.**
   b. All energy used to propel the vehicle must come from the gravitational potential energy derived from the mass of the vehicle. The **entire** vehicle, **including the wheels,** must start from an elevated, non-horizontal position on **the team's** ramp. The ramp must include a release mechanism to hold the vehicle in place without any contact by the competitors.
   c. Transferring the vehicle's gravitational potential energy into elastic devices (e.g., a metal spring) is permissible as long as these devices start at their lowest energy state. Pre-loaded energy storage devices may be used to operate other vehicle functions (e.g., braking system) as long as they do not provide energy to propel the vehicle.
   d. The vehicle's total mass must not exceed **1.500 kg**.
   e. The vehicle must have the point of a **single** bent paper clip which serves as a Measurement Point on either **the leftmost or the rightmost edge/face** of the vehicle between the front and rear axles of the vehicle and extending down to within 1.0 cm of the track's surface when the vehicle is on the track. The point of the paper clip nearest the track surface is used as the reference point for distance measurements and must be easily accessible to the Event Supervisor.
   f. The vehicle and the ramp, **including the release mechanism**, together, in the ready to start position, must fit within a rectangular box **50.0 cm wide x 75.0 cm deep x 200.0 cm high.**
   g. Competitors must release the vehicle by using **any part of** an unsharpened #2 pencil, with an unused eraser (supplied by the Event Supervisor) to actuate the release mechanism **on the ramp**. **Competitors must not use the pencil to touch any part of the vehicle to start the run**. Competitors must **also** not touch the vehicle the release mechanism, **or the ramp** to start the run, **except to prevent the ramp from moving during launch**.
   h. Only the wheels of the vehicle and the ramp are allowed to contact the floor. If any piece falls off during the run, it is a construction violation.
   i. Stopping mechanisms must work automatically. The vehicle must not be tethered or remotely controlled.
   j. Electrical components must not be used on the vehicle, the ramp or any alignment devices.
4. **THE TRACK:**
   a. The competition must be on a straight and level lane with a relatively smooth, hard, low-friction surface. Space is needed on each side of the track's center and beyond the finish line to allow for error in the vehicle's path, otherwise there is no defined track width.
   b. One-inch tape must be used for the Start Line and the tape that contains the Target Point (finish point). The inside edge of the tape must define the Start Line. The Start Line must be 150.0 cm long and the Target Point tape must be at least 2.50 cm long. The Target Point must be marked at the center of this tape. The center of the Start Line will be marked also. This center point and the Target Point will be perpendicularly aligned. There is no Center Line.
   c. At the Event Supervisor's discretion, more than one track may be used. Teams must be given the option to choose which track they will use. All runs by a team must be made on the same track.
5. **THE COMPETITION**:
   a. The vehicle and ramp must be impounded before the start of the competition. Tools, data, and calculating devices need not be impounded.
   b. The Target Distance must not be announced until all vehicles and ramps have been impounded.
   c. Only competitors being judged are allowed in the vehicle impound and track areas while teams are competing.
   d. The vehicle **must not be rolled** on the track surface (floor) **anywhere** at any time prior to or during the competition **except for the two official runs**.

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e. All parts of the vehicle must move as a whole. The competitors must not hold, constrain, or give a push to the vehicle. If any piece falls off during the run, it is considered a construction violation. The vehicle must be able to remain at the starting position without being touched until triggered.
f. Before the first run, the competitors must predict their vehicle's Travel Time. They must not change the prediction for the second run, but they may adjust the vehicle.
g. Competitors have **8** minutes of Event Time to set up, **dry clean the track**, make any changes to the vehicle (including adjusting the Measurement Point) and/or ramp, take measurements, and start two runs. If the second run has started before the **8**-minute period has elapsed, it must be allowed to run to completion. Time used by the Event Supervisor for run measurements does not count toward the **8** minutes Event Time.
h. Competitors must place their vehicle and ramp **anywhere** completely **behind the Start Line.**
i. Sighting and/or aligning devices are permitted on the track but must be removed before the vehicle runs. Aligning and sighting devices mounted on the vehicle or ramp may be removed at the team's discretion prior to each run. Alignment devices left on the vehicle during its run must not cause the vehicle's mass to exceed the **1**.500 kg maximum limit.
j. Run Time starts when the vehicle begins forward motion and ends when the vehicle comes to a complete stop. If a vehicle does not move upon actuation of the release mechanism, it does not count as one of the two runs and the competitors may request to set up for another run, but the time must count toward their **8** minutes Event Time.
k. If the vehicle moves any distance after actuation of the switch, it must be considered a run.
l. Once the vehicle starts a run the competitors must not follow it and wait until called by the Event Supervisor to retrieve their vehicle following measurement. **Time used by the Event Supervisor for assessment and measuring will not be included in the Event Time.**
m. **Prior to each official run, the Event Supervisor will measure the vehicle height, defined to be the highest point of the vehicle in the ready to launch position. This height will be recorded in cm rounded to the nearest whole cm.**
n. Run Time will be recorded **in seconds** to the **nearest** 0.01 seconds.
o. The Event Supervisor is strongly encouraged to utilize 3 independent timers on all runs. The middle value of the 3 timers must be the officially recorded time.
p. If the time and/or distance cannot be measured for a vehicle (e.g., the vehicle starts before the Event Supervisor is ready**, the Measurement Point is no longer within 1 cm of the track at the end of the run,** or the competitors pick up the vehicle before it is measured), it is a failed run that counts as a run with no score.
q. Teams who wish to file an appeal must leave their vehicle with the Event Supervisor.

6. SCORING: Teams are ranked using the single run that gives them the best overall rank.
   a. The Run Score = Distance Score + **Height Score** + Time Score + Predicted Time Score. Low score wins.
   b. The Distance Score is the distance from the Measurement Point to the Target Point in millimeters. This is a point-to-point measurement.
   c. **The Height Score = 400 * Vehicle Height in cm / (300 cm - Vehicle Height in cm)**
   d. The Time Score = **25 *** (Run Time).
   e. The Predicted Time Score = **50*** |(Predicted Time - Travel Time)|.
   f. Tiers:
      i. Tier 1: A run with no violations.
      ii. Tier 2: A run with **any** competition violations.
      iii. Tier 3: A run with construction violations or both competition and construction violations.
      iv. Tier 4: A vehicle that cannot complete any runs receives only Participation Points.
   g. Ties must be broken by this sequence: 1. Better non-scored run; 2. Better Predicted Time Score of better run; 3. Better distance score on better run.

SCORING EXAMPLE: At a competition, **the highest point of the vehicle at ready to launch position was 134 cm** and it stopped 286 mm from the Target Point. It made the run in 4.79 s, and the team's predicted time was 5.52 s.

Distance Score	286.00 points	
Height Score	**322.89 points**	**(400 * 134 cm / (300cm -134 cm)**
Time Score	119.75 points	(25 * 4.79 s)
Predicted Time Score	36.50 points	(50 * |(5.52 s – 4.79 s)|)
Run Score	765.14 points	

Recommended Resources: All reference and training resources including the **Problem Solving and Technology CD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org